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TITLE: Pet food product having oral care propertiesAbstract Text (1):

A pet food product prepared from a fiber containing nutritionally balanced mixture of carbohydrate protein, fat, vitamins and minerals, the product having an expanded striated structural matrix which fractures when chewed by the pet. The product when chewed by the pet exhibits an improved mechanical tooth cleansing function whereby a substantial reduction in plaque, stain and tartar on the pet's teeth is affected. The product is prepared by extruding a plasticized mixture of food ingredients through a discharge passageway, the internal walls of which are maintained at a coefficient of friction no greater than 0.2 so that a condition resembling laminar flow exists in the extrudate.

Brief Summary Text (3):

This invention relates to a solid animal food product having a structural matrix which promotes oral care and hygiene in animals. In particular this invention relates to a pet food product having an expanded, striated structural matrix which when chewed by pets such as dogs and cats, imparts an improved mechanical dental cleansing benefit to the pet's teeth.

Brief Summary Text (5):

Animal pets, such as dogs and cats, like their human counterparts, are subject to dental health problems. These problems can be traced to the formation of bacterial plaque which forms on the exterior surface of teeth. Plaque is a water white gelatinous mass of sticky film of bacteria, polysaccharides and salivary proteins which is not easily washed away. Plaque is now generally recognized as the main culprit of poor oral health. Bacteria that produce the acid for the caries process are held to the tooth surface by the plaque matrix as well as other bacterial agents which cause redness and swelling (gingivitis). The presence of these bacteria, if left untreated, may spread to cause malodor, periodontal disease, gingival pockets and bone loss.

Brief Summary Text (7):

Commercial animal pet foods, when chewed by the animal, do not provide sufficient mechanical surface cleaning to teeth to provide for plaque removal from the animal's teeth necessary for optimum dental health.

Brief Summary Text (8):

A variety of products are manufactured to provide animal pets with objects to chew or gnaw. They are intended to provide the pet with exercise for the teeth to maintain a healthy condition satisfying a need which arose when the natural pet food, raw meat, was replaced with processed pet foods. Rawhide strips knotted on the ends to resemble bones, for example, provide abrasion for cleaning teeth by removing tartar and massaging the gums, which is not provided by the typical canine dog food. The rawhide dog chews are expensive, and the indigestible leather fragments swallowed by the dogs frequently cause severe gastrointestinal blockage or diarrhea.

Brief Summary Text (11):

U.S. Pat. Nos. 5,000,940 and 5,000,943 disclose baked dog biscuits containing an inorganic pyrophosphate salt, e.g., tetrasodium pyrophosphate salt, which when chewed and/or eaten by dogs cause a reduction in tartar accumulations on their teeth.

Brief Summary Text (13):

There is therefore a need in the pet food field for a nutritional food product which is consumable without gastrointestinal complications and effective to abrasively remove plaque when chewed by pet animals such as dogs and cats.

Brief Summary Text (15):

This invention is directed to an extruded animal food product having an expanded, striated structural matrix which, when chewed by the animal, effectively removes tartar, stain and plaque on the animal's teeth through a mechanical cleansing action without causing gastrointestinal distress. When chewed, the striated product fractures along the striations whereby the animal's teeth are retained in increased abrasive contact with the fractured layers, the teeth being abraded and mechanically cleaned by the surfaces of the separated layers as the product is chewed by the animal increasing the time that the product is retained in mechanical cleaning contact with its teeth. The extruded striated product has a low moisture content and is preferably formed from an ingredient mixture of carbohydrate, fat, protein and fiber bearing ingredients and nutritional balancing ingredients such as vitamins and minerals.

Brief Summary Text (16):

During the extrusion process to prepare the food product of the present invention, the ingredient mixture is formed into an expanded, striated product by moving the mixture under plasticizing mechanical agitation and increasing levels of temperature and shear to form a flowable mass which is advanced through a discharge passageway, the inner walls of which have a coefficient of friction no greater than 0.2, to effect a flow state through the passageway resembling laminar flow, whereby the plasticized product is extruded as a continuous strand of product in an expanded and stratified condition with the fibers incorporated in the product flowing in transverse striations.

Detailed Description Text (2):

To manufacture the striated food product of the present invention, one can advantageously use a heatable extruder having one or more transfer screws within a closed heatable barrel and a restricted extrusion discharge passageway such as a die, nozzle or pipe at the front end of the barrel, the internal walls of the passageway being maintained to have a coefficient of friction no greater than about 0.2. The barrel, in conjunction with the screw and die, creates during operation a closed chamber which prevents the release of existing water vapor from the food product and system. The food product mixture of carbohydrate, protein, fat and fiber bearing ingredients is first preconditioned and moisturized with steam and water and then subjected to a plasticizing combination of temperature, shear and pressure in the extruder barrel whereby the ingredient mixture is converted into a flowable mass. The advancing mass builds up sufficient shear to cause the plasticized mixture to be pushed at the desired temperature and pressure to and through the discharge passageway.

Detailed Description Text (4):

Laminar flow is distinguished from turbulent flow which is the normal flow condition of extruded plasticized animal food products. In turbulent flow, fluid elements are in chaotic motion, and small random fluctuations in the velocity at a point will exist even though the average mean velocity may remain constant along its axis. Laminar flow is a flow with constant preparation of streamlines so that constant velocity surfaces remain at constant separation and laminae or sheets of fluid slide frictionless over one another. By creating conditions during the extrusion of the product resembling laminar flow, the fiber bearing ingredients in the product of the present invention are aligned in transverse striations in the product matrix. In contrast, fiber-containing food products which are extruded under conditions of turbulent flow contain the fibrous ingredients randomly distributed in the food product. Such food product, when chewed by an animal, crumbles rather than fractures and exerts limited mechanical cleaning action on the animal's teeth.

Detailed Description Text (6):

By maintaining the inner walls of the passageway at a coefficient of friction no greater than 0.2, and preferably about 0.04 to about 0.1, conditions resembling laminar flow are believed to be induced during the extrusion of the plasticized fiber containing food product of the present invention, and as a result, an extrudate having

a striated structural matrix is obtained; i.e., the extrudate product has fibrous striations transversely aligned through the product microstructure.

Detailed Description Text (11):

In preparing the final product, the moisture content of the expanded extrudate is adjusted to the range of about 5 to about 11%. At moisture levels below 5% the product becomes too hard to be easily chewed by the animal and for this reason moisture levels less than 5% in the product are to be avoided. At moisture levels above about 11% the hardness of the product begins to decrease to levels at which the mechanical cleaning efficacy of the striated product begins to be compromised. Maximum mechanical cleaning efficacy of the striated product is achieved at a density preferably of about 20 to about 30 pounds (lbs.) per cubic foot (ft.^{sup.3}) and a fiber level preferably about 15 to about 20% by weight. At these fiber levels the product has the desired degree of striation to achieve the desired degree of self-adhesion and tooth clinging characteristics.

Detailed Description Text (12):

To further improve palatability and energy (caloric) levels, the dried, extruded striated product may be coated with about 1 to about 13% additional fat.

Detailed Description Text (14):

Suitable ingredients which may be used to prepare the animal food product of the present invention generally contain substantial amounts of animal protein derived from poultry by-products and high protein plant sources such as soybeans as well as fiber derived from sugar beet, soy and pure cellulose and substantial amounts of carbohydrates provided by cereals and grains such as wheat and rice as well as fats (animal or vegetable) such as tallow or soy oil. Small amounts of vitamins, minerals, salts, flavorings and preservatives are also generally included in the food product of the present invention to provide nutritional balance and palatability. A typical nutrient food product of the present invention is prepared from a mixture of the following ingredients:

Detailed Description Text (15):

In preparing the striated matrix animal food product present invention, the mixture of carbohydrates, vegetable and animal protein, fat, fiber and sufficient vitamins and minerals selected to yield a nutritionally balanced diet is mixed and preconditioned or moisturized within a preconditioner or mixing cylinder wherein the ingredients are contacted with steam and moisture. The moisturized mixture is then introduced into an extruder, which can be either a single or twin screw type extruder, which cooks the mixture to yield an extruded product. The extruder is provided with at least one helical screw therethrough which axially rotates to advance the material through the extruder.

Detailed Description Text (18):

In preparing the expanded, striated product of the present invention, the ingredients from which the food product is extruded are first mixed in a mixer such as a ribbon mixer and fed to hopper 11. These ingredients include protein materials such as poultry by-product; carbohydrates such as corn, rice; and fiber such as cellulose fiber; vitamin mix and mineral mix. The mixed ingredients are metered to the preconditioner 18 and admixed with fats such as white grease which are fed directly into the preconditioner 18 at a rate between about 0.2 to 0.4 pounds/minute (lbs./min.). In the preconditioner 18, the mixture of ingredients is fed thereto at a rate between 600 and 1200 pounds (lbs./hr.) and is further mixed with water which is introduced into the preconditioner at a rate of 60 to 140 lbs./hr (1 to 2.3 lbs./min.). The temperature of the mixture is raised from ambient to 170.degree. to 210.degree. F. by the injection of steam into the preconditioner 18 at the rate of 60 to 160 lbs./hr. (1 to 2.7 lbs./min.). Total residence time in the preconditioner 18 generally ranges from 0.5 to 2.5 minutes.

Detailed Description Text (19):

Preconditioning the mixture with steam and water initiates hydration of the carbohydrate and fibrous ingredients which is completed by the mechanical working during the extrusion process.

Detailed Description Text (42):

The significance of the effectiveness of the dog food prepared in accordance with the practice of the present invention is demonstrated in Table II. Based on the mean group scores of Table I, the percent reduction obtained in plaque, stain and tartar obtained with the food products of the present invention (Example) as compared with the commercial comparative products are summarized in Table II below.

Detailed Description Paragraph Table (1):

	Ingredient % by Weight
	<u>Carbohydrate</u> about 35 to about 70 <u>Protein</u> about
10 to about 35 <u>Fat</u> about 10 to about 20 <u>Fiber</u> about 10 to about 25	Nutritional
balancing agents about 0.01 to about 0.40 such as vitamins and minerals	

Detailed Description Paragraph Table (2):

	Ingredient % by Weight
	Corn (Ground) 10-30 Rice Flour 30-50 Cellulose
<u>Fiber</u> 15-25 Poultry By-product Meal 10-15 White Grease Inorganic Salts (NaCl, KCl,	
Ca.sub.2 SO.sub.4) 0.5-2.0 Vitamins 0.01-0.2 Minerals 0.01-0.2 Preservative 0.01-0.2	

Detailed Description Paragraph Table (3):

	Ingredient Weight %
	Brewers Rice 42.220 Yellow Corn 22.895
Cellulose <u>Fiber</u> 19.300 Poultry by-product meal 13.993 Sodium Chloride 0.362 Potassium	
Chloride 0.362 Calcium Sulfate 0.603 Choline Chloride 0.121 Vitamin Mix 0.048 Mineral	
Mix 0.048 Ethoxyquin (Preservative) 0.048	

Detailed Description Paragraph Table (6):

TABLE II	% REDUCTION IN PLAQUE, STAIN AND
TARTAR ACHIEVED WITH DOG FOOD PRODUCT OF PRESENT INVENTION WHEN COMPARED TO COMMERCIAL	
DOG FOOD PRODUCTS % Plaque % Stain % Tartar	<u>Reduction Reduction Reduction</u>
	Commercial Dog 29.7 44.9 23.1 Food I Commercial
Dog 22.6 36.1 21.9 Food II	

CLAIMS:

1. An animal food product comprised of a mixture containing proteins, fats, carbohydrates, fibers, vitamins and minerals the product having a matrix which, when chewed by an animal, is effective for removing plaque, tartar and stain from the teeth of the animal, the matrix being comprised of an extruded, expanded striated product having the fibers aligned in transverse striations through the matrix, the matrix being fracturable, and effective to induce a superior mechanical cleaning action on the animals teeth when chewed.
2. The food product of claim 1 wherein the product is prepared from a mixture containing about 35 to about 70% by carbohydrate, about 10 to about 35% by weight protein, about 10 to about 20% by weight fat and about 10 to about 25% by weight fiber.
5. The method of claim 4 wherein the product is prepared from a mixture containing about 35 to about 70% by carbohydrate, about 10 to about 35% by weight protein, about 10 to about 20% by weight fat and about 10 to about 25% by weight fiber.
7. The food product of claim 1 wherein the fiber is cellulose fiber.
8. A method of preparing an animal food product which is effective for removing plaque, tartar and stain from the teeth of an animal which comprises preparing a food mixture containing carbohydrates, proteins, fats and fiber bearing ingredients, working the mixture under mechanical pressure and heat sufficient to convert the mixture to a plasticized flowable mass and discharging the mass through a die, the internal walls of the die being maintained at a coefficient of friction of from 0.04 to 0.2 so as to obtain an expanded extrudate product having the fiber bearing ingredients aligned in transverse striations through the matrix which, when chewed by an animal, fractures and imparts an improved mechanical cleansing action to the animal's teeth.

11. The method of claim 8 wherein the fiber bearing ingredients are cellulose fiber.